 

# Development of Approximate Waste Management Strategies for Drilling Waste-Niger Delta(Nigeria) Experience

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**Abstract**
Drilling waste is one of the most problem encounted in oil and gas industry.The challenge has been to develop the most appropate waste management strategies to minimise these waste . Oil and gas well drilling processes generate large volume of drill cuttings and spent mud. Onshore and offshore operators have used a variety of methods to manage these drilling wastes.This paper looks at the global best practises of managing these waste and come up with the most and widely acceptable methods of waste reduction from the source. It addresses the various stages in drilling waste management, and emphasizes the phases of waste identification, minimization, treatment and disposal as integral parts of waste management process.
**Keywords:** disposal, drillingfluid, management, process modification, waste.

## Introduction

The process of drilling oil and gas wells generates two primary types of wastes; these include used-drilling fluids and drill cuttings. Drilling fluids (also known as muds) are used to aid the drilling process, the fluid phase can be water, synthetic or natural oils, air, gas, or a mixture of these components. Muds consist of a base fluid and various solid and liquid additives to allow for good drilling performance. Some of the additives introduce potentially toxic compounds into the fluids, which must be considered when the resulting wastes are managed. The main pollution of spent muds are caused by: biocides. oil, completion or stimulation fluid components, corrosion inhibitors, reservoir fluids (crude oil, brine), and drilling mud chemical components [1].
Drilling wastes are the second largest volume of waste, behind produced water, generated by the E&P industry [2]. API estimated that in 1995 about 150 million barrels of drilling waste was generated from onshore wells in the United States alone [3]. Operators have employed a variety of methods for managing these drilling wastes depending on what federal regulations allow and how costly those options are for the well in question. These include underground injection, thermal treatment, and biological remediation.
Many of the additives used in the past for drilling fluids have contained potential contaminants of concern such as chromium in lignosulfonates. Also, barite weighting agents may contain concentrations of heavy metals such as cadmium or mercury. The use of such additives has diminished. However, an operator should take care to select additives that are less toxic and that will, therefore, result in a less toxic drilling waste.

### Source Reduction of Drilling Waste

#### 1) Slim Holes

The drilling industry has improved the technology of “slim hole” drilling over the past few years [3]. Slim hole drilling should be considered when planning a drilling project. This is the best aproach to source reduction of drilling waste. If feasible and used, slim hole drilling reduces the volume of waste drilling fluid and the volume of drill cuttings. The total cost of a slim hole drilling operation may be considerably less than for conventional whole sizes due to the reduced fluid system and waste management costs. Also, smaller casing is required, which may help reduce the total cost of the operation.

#### 2) Solids Control

An effective way to reduce the volume of drilling fluid waste is the use of solids control [5]. The efficient use of solids control equipment (e.g., hydrocyclones and centrifuges) in combination with chemical flocculants minimizes the need for makeup water to dilute the fluid system. An enhanced solids control system designed to compliment a specific drilling operation is a very effective waste minimization technique.

#### 3) Mud System Monitoring

Diligent and comprehensive monitoring of drilling fluid properties is effective in reducing the frequency of water and additive additions to the system. Monitoring the system allow the operator to immediately identif’ unwanted changes in the drilling fluid system and make the necessary corrections. This technique, in addition to the solids control for the drilling fluid system can significantly reduce the costs of the drilling fluid system and the volume of drilling waste remaining at the end of the drilling operation [1].

### C. Material Re-use or Recycle

Many of the materials in the drilling waste stream can be used more than once or be converted into a usable material. For example, reconditioned drilling mud could be reused for other wells, either by the operating company or by the vendor. Waste mud from one well can be used for plugging or spudding other wells. Used drilling mud can also be used to make cement [7]. Used OBMs and SBMs can be recycled where possible.

 

Recycling avoid release of large quantities of wastes into the environment.

**D. Treatment and Disposal**

Treatment is used to reduce the volume and/or toxicity of wastes and put them in a suitable position for final disposal. Treatment and disposal options depend largely on the waste characteristics and regulatory requirements. There are various practices to get rid of drilling wastes in the oil and gas industry today. They are: onsite burial, land farming, thermal treatment, slurry injection and bioremediation.

**1) Onsite Burial**

Burial is the placement of waste in man-made or natural excavations, such as landfills. Burial is the most common onshore disposal technique used for disposing of drilling wastes (mud and cuttings). Generally, the solids are buried in the same pit (the reserve pit) used for collection and temporary storage of waste mud and cuttings after the liquid is allowed to evaporate. Pit burial is a low-tech method that does not require wastes to be transported away from the well site, and, therefore, is very attractive to many operators.

Burial may be the most misunderstood or misapplied disposal technique. Onsite pit burial may not be a good choice for waste that contain high concentrations of oil, salt, biologically available metals, industrial chemicals, and other materials with harmful components that could migrate from the pit and contaminate usable water resources.

In some oil field areas, large landfills are operated to dispose of oil field waste from multiple wells. Secure landfills are specially designed land structures which employ protective measures against off-site migration of contained chemical waste via leaching or vaporisation . Burial usually results in anaerobic conditions, which limits any further degradation when compared with waste that are land-farmed or land-spread; where aerobic conditions predominate.

**2) Land farming**

Land farming involves spreading the waste on a designated area of land and working it into the soil. The objective of applying drilling wastes to the land is to allow the soil's naturally occurring microbial population to metabolize, transform, and assimilation waste constituents in place. It may be safely utilised as a means of immobilising and biodegrading many oilfield wastes. Soil loading capacity must be known and should not be exceeded in order to maintain aerobic condition at site.

**3) Incineration**

Incineration is one of the best thermal treatment disposal options because thermally treated wastes are decomposed to none or less hazardous by-products. Controlled incinerators operate at sufficient temperatures for complete thermal decomposition of hazardous wastes. In addition, solid and gas emissions are controlled by afterburners, scrubbers, and/or electrostatic precipitators.

Non-hazardous and hazardous solids, liquids, and gases can be incinerated. However, incineration of heavy metals such as lead, mercury or cadmium is not recommended because these metals remain in the fly ash and present a leaching hazard when placed in a landfill. The advantages of incineration are numerous, including volume reduction, complete destruction rather than isolation, and possible resource recovery.

**4) Thermal desorption**

Thermal desorption process applies heat directly or indirectly to the wastes, to vaporize volatile and semi volatile components without incinerating the soil. In some thermal desorption technologies, the off-gases are combusted, and in others, such as in thermal phase separation, the gases are condensed and separated to recover heavier hydrocarbons. Thermal desorption technologies include indirect rotary kilns, hot oil processors, thermal phase separation, thermal distillation, thermal plasma volatilization, and modular thermal processors.

**5) Deep-well Injection**

This is a waste disposal technique where drill cuttings and other oilfield wastes are mixed into slurry. The resulting slurry is then injected into a dedicated disposal well where it is contained in the pores of permeable subsurface rocks far below freshwater aquifers. The primary disadvantage of this option is the possibility of freshwater contamination due to casing failure. Availability of the disposal option is also limited to certain geological setting. It is environmentally preferred when rock formations allow.

**6) Vermiculture**

Vermiculture is the process of using worms to decompose organic waste into a material capable of supplying necessary nutrients to help sustain plant growth [7]. For several years, worms have been used to convert organic waste into organic fertilizer. Recently, the process has been tested and found successful in treating certain synthetic-based drilling wastes [6]. Researchers in New Zealand have conducted experiments to demonstrate that worms can facilitate the rapid degradation of hydrocarbon-based drilling fluids and subsequently process the minerals in the drill cuttings [2]. Because worm cast (manure) has important fertilizer properties, the process may provide an alternative drill cutting disposal method.

## V. WASTE MANAGEMENT STRATEGIES

Successful implementation of waste management plan requires that the operations personnel generating and handling the wastes should be communicated adequately as to the available options there is to effectively manage waste. present a typical drilling waste management strategy. The first and most important action in the waste management hierarchy is to reduce the volume of waste generated. The next is to recycle or reuse the wastes or materials in the wastes. Only after these should the remaining wastes be treated and disposed. By following this hierarchy, both the volume of waste to be disposed and the ultimate disposal cost will be minimized.

## VI. CONCLUSION

The following conclusions can be drawn:
1. That oil and gas well drilling activities generate large volume of drilling cutting s and spent mud.
2. That environmental impact of oil and gas well drilling can be classified into descriptive types such as acute, sub-acute, sub-chronic and chronic.
3. That most concentrations of oil and gas well drilling wastes encountered during drilling activities are relatively low and impacts are generally noticed after chronic exposure.
4. That the preferred sequence of drilling waste management option should be source reduction, waste recycling or reuse, waste treatment and waste disposal.
5. That waste minimization techniques via process modification include slim hole drilling, solids control and mud system monitoring.

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